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JACQUES LOEB

JACQUES LOEB, THE MAN

JACQUES LOEB, savant, philosopher, mechanist, satirist, rebel, crusader, humanitarian—of whom shall I write these lines? The man is so big and still so near—too difficult to be embraced by a friend's eye, more so to be analyzed. I see his face, sunshine and shadows, smiles and frowns. How rapidly they interchanged, each capturing by its own force. Mankind and its weaknesses were his concern and the thoughts of these brought on the clouds, but to him, nothing was so sad as to be void of the humorous and thus the very grief begot amusement. And then there was Science, the guardian, the hope, the weapon!

I see Jacques Loeb at his desk in his modest home among his devoted family and surrounded by pictures of his spiritual friends, Voltaire, Diderot, D'Alambert, the men who dreamed of a realm where Reason was supreme authority, where all the crudities of superstition and outlived traditions were no longer permitted to crush human aspirations and human ambitions, where tolerance towered above all virtues. In them Jacques Loeb found his inspiration, their dreams became his dreams, their ideals he sponsored and to them he remained loyal and true through all his career and under all circumstances. It may not seem credible that a man who in his main pursuit was led by pure intellect should be moved by a motive emotional, should be inspired by the fire of a poet, by the zeal of a crusader. But such is the truth.

The efforts of Voltaire, Diderot and the entire group of encyclopedists were not in vain. The great French Revolution is the monument to their lives. But years passed and new tyrannies arose, new superstitions superseded the old and some of the old took a renewed hold. Times have changed and the methods of the old humanitarians no longer fitted the new conditions. Words, beautiful as they may be, eloquent as they may sound, were not the weapon Jacques Loeb chose to use in his struggle against superstition, in his crusade for intellectual freedom and for mutual tolerance. His ambition was to convince by realities hidden from the common eye. Thus, Jacques Loeb espoused Science, not merely as a career, nor as a medium to satisfy his personal curiosities. Science became his idol, his armor and his armament.

I see Jacques Loeb in his laboratory, again simple, surrounded by very few instruments and apparatus. From the walls are looking at him his old friends,

Arrhenius, Van't-Hoff and Ostwald. Later the group was enlarged by Rutherford, Einstein and others. To them his eyes often turned for support and sympathy. It is here that the rebellious spirit inherited from Voltaire and fortified by revolutionaries in modern science found its full expression. Academic problems did not interest him; popular problems bored him. His weapon was always directed towards phenomena which had been surrounded by mystery and still more by superstition. In his quiet composed way, with tools as simple as toys, he gave battle after battle. As a Napoleon he tore to tatters the mantle of mystery from one phenomenon after another. His attacks were nearly always directed against phenomena which for generations had been considered supernatural—phenomena which academies by tradition regarded as lying beyond the scope of human analysis. Thus, in one of his first endeavors, he threw his gauntlet to the old metaphysical philosophers and dared from the behavior of plants to explain the workings of the human will. Such was the origin of the work on tropisms and on the physiology of the brain. Later came other challenges. Parthenogenesis, regeneration, senescence; phenomena so much used in support of the ideas of vitalism were all divested of their mystery and presented in the simple light of rationalism.

Jacques Loeb realized the responsibility of his position. He anticipated criticism and antagonism. He realized that the more fantastic his ideas might seem, the saner must be the method which led to them. Thus, from the very beginning, his efforts were directed to support his doctrines by the methods of sciences which are the oldest and the most accurate; by mathematics, physics and chemistry. His true genius was in the discovery of simple systems in which life manifested itself in a simple way accessible to analysis by the methods of accurate sciences.

P. A. LEVENE

JACQUES LOEB, THE SCIENTIST

The death of Jacques Loeb at the zenith of his career comes as a great shock to all who knew him. His loss will be keenly felt not only among biologists but among men of science throughout the world.

I shall not here attempt to disclose the qualities which quickly made him a recognized leader in biology or the personal traits which endeared him to an ever widening circle of devoted friends. It need only be said that his goodness is an open book to all who knew him and his greatness will loom even larger with the lapse of time.

Of his influence on biology it would be difficult to give an adequate account. All his fellow-workers felt its spell and his death will not impair it: many who never knew him will be unconsciously guided by it in ways little guessed.

His conceptions were often so bold and original as to startle conventional thinkers. Fearless in attacking difficult questions of fundamental importance, he showed almost uncanny insight into the most obscure and baffling matters. His discoveries often had a dramatic quality in their unexpected and beautiful solutions of perplexing problems. His results were reached by methods so simple as to compel admiration. His papers were always clear, cogent and convincing. It is no wonder that he was a powerful stimulus to his fellow-workers.

His mechanistic view-point profoundly affected biology and medicine and had an important influence on psychology and philosophy.

It is possible only to recall some important facts in his career, which to so many has served as example and inspiration.

He was born in Mayen, Germany, April 7, 1859. He attended the Askanisches Gymnasium in Berlin, 1877–1880; the Universities of Berlin, 1880; Munich, 1880–81; Strassburg, 1881–1885 (M.D., 1884; Staatsexamen, 1885), and in 1885–1886 he was again at the University of Berlin.

He was assistant in physiology at the University of Würzburg, 1886–1888, and at the University of Strassburg, 1888–1890. From 1889 to 1891, at the Naples Zoological Station, he laid the foundation for his work on marine biology which was afterward continued at the Marine Biological Laboratory at Woods Hole, Massachusetts, and at Pacific Grove, California. In 1891 he came to America and became associate in biology at Bryn Mawr College. From there he went to the University of Chicago as assistant professor of physiology and experimental biology in 1892; later he became associate professor, and then professor of physiology. In 1902 he accepted the professorship of physiology at the University of California. In 1910 he became Member of The Rockefeller Institute for Medical Research and remained there until his death.

Attracted in his student days by certain aspects of metaphysics, he became especially interested in problems connected with the freedom of the will. The idea that certain brain functions are localized in definite centers and that human conduct may be profoundly affected by disturbances in these centers led him to study medicine to gain the technical knowledge needed for experiments in order to learn to what extent apparently volitional acts can be controlled by physical and chemical agencies. These studies led him, before the age of thirty, to the revolutionary conception that the actions of animals may be largely explained on a physicochemical basis. He took from the botanist, Julius Sachs, the idea of tropisms and applied it to animals. He sought a mechanistic explanation of animal conduct which should drop the

question of purpose and reduce the reactions of animals to quantitative laws. His researches in this field are summarized in English in two volumes, "Comparative Physiology of the Brain and Comparative Psychology" (1900) and "Forced Movements, Tropisms and Animal Conduct" (1918).

He next undertook to control the growth and form of animals by physical and chemical means. The studies in this field, which he named "Physiological Morphology," covered a very wide range and continued to receive his attention up to the time of his death. The goal at which he aimed was to secure the same degree of control over living matter that the chemist and physicist have over their material and he felt that the best prospect of success lay in applying their methods to biology.

It was characteristic that in the pursuit of these researches he was prompt to utilize recent discoveries in physical chemistry, particularly those connected with the ionic theory and the theory of osmotic pressure. From 1897 on he published papers applying these theories to biological phenomena and they may be said to form the leitmotif of his subsequent work. Out of them arose, almost at once, two important discoveries, antagonism and artificial parthenogenesis. Both resulted from experiments of the simplest kind, carried out on marine organisms.

It was found that the fish, *Fundulus*, can grow and develop in distilled water but soon dies if sodium chloride is added. The addition of other salts, particularly those of potassium and calcium, which are themselves toxic when they alone are present, produces a harmless solution. Loeb called this a balanced solution, that is, one in which the toxic effects of one substance are offset by the antagonistic action of other substances. This conception proved to be a fruitful one.

As the result of subsequent experiments he concluded that these facts may be accounted for by the effects of the antagonistic substances on the permeability of the protoplasm. It may be added that his experiments on permeability, which covered a wide range, led to the conclusion that Overton's hypothesis is untenable.

His experiments on artificial parthenogenesis may be truly called epoch-making. In 1913 he reviewed them in a volume entitled "Artificial Parthenogenesis and Fertilization" (following the publication of two volumes on this subject in German). He continued work in this field for some years after the publication of this volume. He aimed at a complete analysis of the mechanism of fertilization, development and heredity. His work on fertilization indicated that the principal function of the sperm in stimulating development is to carry into the egg a substance which produces a surface change leading to the production of the fertilization membrane. This effect could be brought about, independently of sperm, by a variety of physical and chemical agencies.

At the same time he succeeded in finding means to bring about crosses which never occur in nature. By a slight change in the composition of the sea water eggs could be fertilized by sperm of other species which could not normally enter the egg.

In the course of these studies a great number of questions presented themselves which excited his keen interest. The variety and extent of these problems can only be realized by a careful consideration of the contents of the volumes entitled "Studies in General Physiology" (1905), "Dynamics of Living Matter" (1906), "The Mechanistic Conception of Life" (1912) and "The Organism as a Whole" (1916).

Among theese subjects may be mentioned the rôle of oxygen in metabolism, toxicity and development. Another in which he was deeply interested is the cause of natural death and the means of lengthening life. In the course of these studies he found that in certain cases low temperature prolongs life to a remarkable degree. In this connection it may be recalled that the first studies on the temperature coefficient of the heart beat and of the transmission of stimuli in nerves were made by his students.

Another investigation which he initiated, and which grew naturally out of these studies, showed that the electric potentials existing in the organism can, in many cases, be accounted for qualitatively and quantitatively by relatively simple means, and that they can be imitated to a considerable extent by artificial models.

As he truly said, many biologists accept a mechanistic explanation of various functions of the organism but fail to employ mechanistic conceptions in dealing with the larger problems of organization and adaptation. It was, however, precisely these problems which fascinated him and he did not hesitate to attack them from his point of view. He showed that many characteristics of the organisms which are regarded as adaptive may be explained on a mechanistic basis. He felt that here, as elsewhere in biology, progress requires quantitative investigation and with this in view he began the quantitative studies on regeneration upon which he continued to work until his death. His latest book, "La nature physiochemique de la régénération" (Paris, 1924), is devoted to this subject.

His work began, as was said, with questions concerning the freedom of the will. But he found that in order to study these he must attack the simpler problems involved in the behavior of lower organisms. These in turn required for their understanding a study of the physical and chemical reactions on which they are based. It is, therefore, not surprising that in the closing years of his life he came to devote his attention almost wholly to the properties of col-

loids, upon which life phenomena so largely depend. In a recent volume on "Proteins and the Theory of Colloidal Behavior" (1922) he contends that the behavior of colloids may be explained by the ordinary laws of chemistry without recourse to theories based on adsorption. As in earlier researches he had found a clue to the solution of many problems by applying the theories of electrolytic dissociation and osmosis, so in the work of his later years he discovered a guiding principle in the theory of the Donnan equilibrium. By applying this he was able to give quantitative explanations of some of the most important properties of proteins and to reduce them to simple mathematical laws. These studies, important for chemistry as well as for biology, form a fitting termination of his activity.

Thus closed a career rich in the joy of pioneer adventure in fresh fields of thought, abounding in brilliant discoveries, and splendidly stimulating far beyond the boundaries of biology. It will always stand out as a poriment feature of the progress of biology toward the status of an exact science. It is a career which reveals everywhere a creative imagination and capacity found only in minds of the highest order.

W. J. V. OSTERHOUT

THE SUBJECT-MATTER OF A COURSE IN PHYSICAL CHEMISTRY[1]

THIS is not intended to be a pedagogical paper. Rather, it is proposed to review briefly the recent progress in theoretical chemistry with the idea of suggesting how the content of the more or less classical course in physical chemistry should be altered. It is quite likely that recent progress will indicate that the emphasis should be shifted from some subjects to others, and it is not unlikely that some of the ideas we have been imparting to the students in the past may in the light of recent developments prove erroneous.

Some instructors in political science, I believe, are wont to present to students the various theories of applied government, old and new, without prejudice, leaving the student to choose for himself those which appear the more logical or feasible. The student thus occasionally becomes infatuated with some highly ingenious theory such as the single tax, to the great disgust of conservative tax-payers who proceed to denounce the university for the inculcation of radical ideas. Now such procedure may be entirely justifiable in the more controversial sciences, but it does not appear desirable in the teaching of theoretical chemistry. In the first place, theories in chemistry are subject to immediate experimental verification and while the results are sometimes ambiguous, if a theory has failed to establish itself after years of experimental test, we may conclude that it is badly conceived, or at least not likely to prove fruitful as a guide to new facts. In the second place, in the limited time available, we can scarcely make the undergraduate familiar with the well-established fundamental principles of theoretical chemistry, and we certainly have little time to spend upon matters of speculation and controversy.

The logical although perhaps not the best psychological way to begin a course in physical chemistry is to develop the concept of the atom and its structure. If we begin this way, the laws of combining weights and multiple proportions become mere axioms, while the experimental work in radio-activity, X-ray study of crystallography and positive rays become exhibit A in proving the case for the existence of the atom. To begin the structure of the atom, we have the Rutherford nucleus, although recent work is said to show that the experiments which Rutherford used to demonstrate the existence of a small nucleus might equally well be used to prove that the atom had the constitution originally assumed by J. J. Thomson. Nevertheless, the work of Bohr and Lewis has given us a picture of the structure of the atom which is sufficiently definite and which explains the necessary and important properties of the atom. While this picture leaves many things to be desired, the evidence for its validity is as direct and abundant as was the evidence thirty years ago for the existence of the atom itself. And one of the greatest mistakes that the physical chemist has made was his adoption under the leadership of Ostwald of an agnostic attitude toward the existence of the atom.

One of the most important things that we can do is to give the student an up-to-date model of the periodic table. The old Mendeleieff table attempted to show only the chemical relationships of the elements and it did that rather badly as its author himself realized. An improved periodic table ought (1) to be based upon atomic number instead of atomic weight, (2) it ought to show the number of valence electrons, (3) it ought to show the number of shells of electrons, (4) it ought to show the real chemical resemblances, (5) it ought to indicate the degree to which the element possesses the property whose presence is variously designated as electronegativity or acidity and whose absence is termed electropositivity or basicity. Now in the nature of things it is not possible to arrange a table which will comply completely with all these requirements. If anything is to be sacrificed, I should prefer it to be some of the far-fetched chemical resemblances.

Any arrangement of the periodic table should pre-

[1] Paper presented at the Cincinnati meeting of the American Association for the Advancement of Science, Section C.

serve the Rydberg periods. The arrangement which seems to be most instructive is one of 16 columns and 7 rows. Each row represents a shell of electrons and the maximum number of valence electrons is characteristic for each column, starting with 1 for the alkali metal column at the left and running up to 8 for the platinum group, then starting over again with 1 for silver and increasing up to 8 for the rare gases. In such a table the transition groups, such as iron, cobalt, nickel, the platinum metals and the rare earths, are each assigned a single place in the table. Cerium is the one element which might appear twice in the table. Hydrogen is placed with the halogens. The only important chemical resemblances not shown are relations such as that of Mg to Zn and these relations can be very nicely indicated if we draw dotted lines dividing the table into zones of equal electron affinity.

The amount of information presented to the eye by such a table is enormous and it is my opinion that with nothing more than Coulomb's law, the mathematical physicist will some day calculate the chemical properties of every element quantitatively. At any rate, with nothing more than Coulomb's law and the concept of successive electron shells we can predict qualitatively the electronegativity of every element.

I had hoped that we might be able to substitute electron affinity or ionizing potential for the wretched term electronegativity, but these quantities are measured for the gaseous state and our ordinary chemical properties are concerned with the condensed phases. For instance, the electron affinity of the chlorine atom is less than the ionization potential of sodium, so that a chlorine atom should never rob a sodium atom of its electron, and yet nothing is more certain than that it does so in a solution of sodium chloride.

And while we are on the subject the greatest need of the theoretical chemist to-day is a definite concrete language. Some of you have, no doubt, been wondering how we are going to give our students a complete understanding of the chemical properties of the elements in terms of atomic structure, when there is so little agreement among the leaders in thought in chemistry as to the interpretation of the facts. Well, as a matter of fact, the reason that so few chemists agree on anything is that so few chemists talk the same language. The curse of the chemist is the use of indefinite expressions. The so-called chemical intuition about which we hear so much is nothing more than the ability to recognize an obvious experimental generalization even when it is couched in language that is ambiguous and indefinite. Somebody has said that one of the social sciences expresses things that everybody knows in language that nobody can understand, but this statement is dangerously near to being true of the jargon of the theoretical chemist. Such expressions as polar, negative, electronegativity, residual affinity, partial valency, unsaturation, etc., have been used over and over again with radically different meanings, often in the same article. It is for this reason that most of the speculative articles which have been published regarding the important chemical properties which these words are supposed to represent, will, when translated and analyzed, be found to be the purest nonsense.

The development of the laws of combining weights and multiple proportions by inductive reasoning (assuming that they were arrived at in that way) constitute one of the most difficult achievements of the human mind, and the teachers of chemistry are so impressed with this achievement that, on the one hand, they try to make the freshman repeat it, which is disastrous for the freshman, and, on the other hand, they continue to talk chemical phenomena with inductive vagueness when they should be doing a little deductive reasoning from Coulomb's law of electrostatics.

Recently a book has appeared whose main theme is the beauty of the scientific method as a means of drawing accurate conclusions from existing data and the desirability of extending this method to the political affairs of mankind. Now whether this book be overly enthusiastic or not, the fact remains that the members of this meeting could not agree upon any single fundamental statement of the relation of chemical properties to atomic structure. I believe, however, that the reason is chiefly that no two people would be trying to say the same thing, let alone use the same language. The older generation of chemists in conclave is in the same predicament as the multitude that happened to be present at the raising of the tower of Babel. The only hope is with the younger generation. If we teach them the electrical nature of matter, make the electron a reality with the fundamental laws of physics as a working rule, then we will have a generation of chemists who will be able to converse with one another. Nor is this ambiguity confined to the chemist. When I hear a physicist speak of a Helmholtz double layer it always gives me a hopeless feeling. In the early stages of science, when investigators were struggling in the dark, it was inevitable that their communication with each other would be difficult, but now that the light has been turned on we should become articulate. Let us hope that the near future will bring us many of the sort of clarifications of meaning that G. N. Lewis achieved when he pointed out that an acidic group was one that was seeking a pair of electrons and a basic group was one that had a pair of electrons that it was willing to share.

The kinetic theory ought to be given a greater emphasis than ever before. The derivation of the per-

fect gas law from kinetic theory is the most elegant piece of reasoning we have in physical chemistry. The time usually spent on deviations from the perfect gas law and Van der Waal's equation is probably wasted, for we actually treat all gases as perfect in our ordinary work and with reason. I wish that we could say as much for the perfect solution.

The rapid progress of the quantum theory means that the chemist of the future must study the kinetic theory from the standpoint of statistical mechanics. I should be surprised if there is any process of chemistry to which the quantum theory will not be applied. Processes such as rates of reaction, which we have always supposed to be continuous, are being found on close scrutiny to be discontinuous. The people who a year or two ago became excited over radiation as a cause of chemical action overlooked the fact that the kinetic theory together with the quantum theory will explain any phenomenon so far disclosed in regard to rate of reaction. The mechanism of evaporation is to be explained by the kinetic theory. But the student must be taught the kinetic theory from the standpoint of statistical mechanics. Maxwell's law of distribution for the total kinetic energy of a gas molecule is probably the most useless expression in molecular physics. I believe that shortly we will be teaching juniors the methods of statistical mechanics, which, a few years ago, were buried in the works of Boltzman and Gibbs.

On the other hand, it is a clever teacher who can give an honest presentation of the laws of solutions and retain the respect of his students. The perfect solution is almost a fiction of the imagination. Until we can get some kind of an empirical equation of state for solutions that will serve as an approximation, I suspect we are wasting time on solutions. Perhaps we could lump these doubtful subjects which do so much to discredit chemical theory with the student under a chapter on the "Experimental determination of limiting values." Thus we can show the student that exact molecular weights of gases may be calculated from limiting densities, the exact molecular weights in solution from freezing points of very dilute solutions and accurate percentage ionization for weak electrolytes from conductivities, if the electrolytes are weak enough. Put in this way we are teaching a scientific method of great beauty and usefulness, but we should make a great mistake if we try to pretend to the student that we know anything about solutions.

The next topic that we must consider is the one that monopolized physical chemistry for 30 years to its detriment, I fear, *viz.*, the ionization of electrolytes. The followers of Ostwald talked about the migration of hydrogen ion instead of hydrogen ions because they didn't believe in atoms and it is no wonder that their thinking was rather ineffective. At any rate, omitting mention for lack of time of a number of attempts in this direction, the first successful application of the laws of electrostatics together with the kinetic theory to solutions of strong electrolytes has been made by Debye within the present year. We can not hope to treat concentrated solutions of strong electrolytes until we know the exact dimensions of ions, nor can we hope to calculate irreversible phenomena such as conductivity. But in dilute solution, Debye's theory leads to exactly the same equation for the lowering of freezing points by electrolytes that was deduced empirically by G. N. Lewis from a scrutiny of all existing data. I think Debye's work must revolutionize our treatment of strong electrolytes. Debye assumes the existence of a completely polar electrolyte. Now probably there are no completely polar electrolytes, just as there are no perfect gases, but we have real gases like helium that are very nearly perfect and we must admit that a salt like potassium chloride is very nearly completely polar. Debye's picture of an electrolyte in solution is that the positive and negative ions are not distributed at random, but that there is a tendency for a positive ion to be surrounded by negative ions and vice versa. Thus, even in the most dilute solutions with which we work, the ions are still close enough together to exert appreciable attractions on each other and cause a negative deviation from Rault's law. You see what this does to the concept of dissociation. If we say that an ion is dissociated only when it is out of the sphere of influence of any other ion then a 0.001 molal solution of potassium chloride is completely undissociated. On the other hand, if we say that two ions are dissociated unless they are arranged exactly as in the crystal, then a solution of potassium chloride is practically completely dissociated at any concentration. All this, of course, applies to strong electrolytes. The dissociation of acetic acid is undoubtedly a chemical reaction with a true equilibrium.

Apparently one feature that should receive more emphasis with students is the nature of ionic reactions. The typical ionic reaction is of a radically different behavior from the typically non-ionic reaction and yet many chemists to-day fail to perceive the distinction. We can always detect the presence of ions by conductivity. The forces of an ion are free and an ion is always ready to react. On the other hand, reactions between molecules require that the molecules collide with some critical momentum and a proper orientation. Molecular reactions are slow, ionic reactions are rapid. Typical examples are the precipitation of $BaSO_4$, on the one hand, and the hydrolysis of an ester on the other.

Also, if the student is to understand and compre-

hend he must be taught to think in terms of hydrogen ion concentrations. The use of pH is like the use of degrees Beaumé. Specialized industries like to develop their special jargon. It makes numerical details easier to remember and it makes the outsider feel more ignorant. It is all right to use pH if you know what it means. Likewise, one might say for the benefit of our friends in the allied sciences that it is all right to use a hydrogen electrode if you know what you are doing.

There remain only two or three topics to mention. The phase rule is apparently becoming relatively less important in theoretical chemistry. Of rates of reaction and the mass law in solutions we shall have to speak softly. But equilibrium and rate of reaction in the gaseous phase has become of greater interest than ever from recent experimental work, and the student is not likely to get too much of them.

In this paper it is hardly necessary to mention thermodynamics, the faithful handmaiden of physical chemistry. Twenty years ago, we had many branches of exact science, mechanics, electrodynamics, etc. The wave of heresy known as the quantum theory came. Perhaps it will pass. At any rate, to-day the only branch of physical science in which we put an unfaltering trust is thermodynamics.

The early chemists started to develop the idea of chemical affinity. Then they met with the phenomenon of chemical equilibrium and they abandoned the affinity idea in favor of the law of mass action. But each view is partially right. Atomic structure tells us of chemical affinity; statistical mechanics predicts the effect of thermal energy; what happens to matter is the resultant of the action of these two agents. Apparently the theoretical chemistry of the future will consist almost entirely of these two subjects.

WORTH H. RODEBUSH
UNIVERSITY OF ILLINOIS

THE HARVARD BOTANICAL GARDEN IN CUBA

A TROPICAL STATION FOR GENERAL BIOLOGICAL RESEARCH

SOME twenty years ago, Mr. E. F. Atkins set aside a portion of his estate at Soledad near Cienfuegos, Cuba, for development into a tropical botanical garden, with special facilities for plant breeding. At an early date Mr. Atkins secured the cooperation of the late Professor George L. Goodale and of Professor Oakes Ames to help carry out his plans, and since this time the work has progressed continuously.

Mr. R. M. Grey, the superintendent during this period, has been indefatigable. A collection of nearly two thousand species of tropical plants has been brought together from various parts of the world, including particularly fine aggregations of palms and of tropical fruits. All the important fruits of the tropics are now represented, the varieties of mangos, of citrus fruits and of avocados being especially extensive. In addition, a great many crosses have been raised and tested on a large scale. Mr. Grey has been particularly interested in sugar cane breeding, and his work on this crop has been second to none in the Americas, but his work on citrus fruits, cotton, mangos and guavas is also worthy of mention.

From these statements, it will be seen that the Harvard Botanical Garden in Cuba has long been a going concern, with exceptional facilities for tropical research in botany. Unfortunately, the garden has not been able hitherto to accomplish the purpose for which it was designed by its founder, because of the lack of laboratory and of living quarters.

Through the generosity of Mr. Atkins, this difficulty has now been removed, and it is the hope of both the founder and the corporation of Harvard University that the garden will become one of the centers of tropical research in America. There is a substantial endowment for work, and a handsome brick and stucco building which is to serve both as laboratory and living quarters for investigators.

LOCATION OF THE GARDEN

The Harvard Botanical Garden is on the southern side of Cuba six miles from Cienfuegos and may be reached by rail from Havana in about nine hours. The land on which it is situated is the rolling plain typical of the sugar estates of Santa Clara province. The garden itself is well watered and furnishes soils of several types upon which almost every sub-tropical plant can be grown to advantage. Near the garden is a second-growth jungle of several acres. Twenty miles to the east lie the Trinidad Mountains rising over 2,000 feet from the surrounding plain, partly untouched by the cultivator and partly planted to coffee. To the south, reached in one hour by boat from Soledad, is Cienfuegos Bay, one of the wonder harbors of the world.

FACILITIES FOR INVESTIGATION

The Harvard Botanical Garden in Cuba will be of primary interest to the botanist, but it is really a general biological institution offering extraordinary opportunities to the zoologist and physiologist.

To those interested in land plants and animals, the garden itself will be an inexhaustible source of material. The plant pathologist, the plant breeder, the physiologist and the entomologist need never lack interesting and important problems. The taxonomist, be he zoologist or botanist, will be long in exhausting the possibilties of the surrounding country.

Those wishing to investigate marine forms have only to take a short trip down the Caunau River to the Milpa on the inner neck of Cienfuegos Bay where they can be accommodated at Mr. Atkins's commodious summer place.

EXPENSES

Rates from New York to Cuba by water are very low, and those accepted as resident investigators will be under merely nominal expenses while working at the garden.

Those who desire to apply for a table should state what problem they wish to undertake and when they expect to be in residence. For further information address Professor W. M. Wheeler, dean, or Professor I. W. Bailey, secretary, The Bussey Institution of Harvard University, Boston 30, Mass.

E. M. EAST

BUSSEY INSTITUTION,
HARVARD UNIVERSITY

SCIENTIFIC EVENTS

IMMUNIZATION AGAINST PNEUMONIA

THE Influenza Commission of the Metropolitan Life Insurance Company announces the discovery of a new treatment for pneumonia which holds out the definite hope of accomplishing a radical reduction in the death rate of this disease, so often a sequel to influenza.

Dr. Lloyd D. Felton, assistant professor of preventive medicine and hygiene in the Harvard Medical School, working in the department of preventive medicine and hygiene, has found a method of precipitating and concentrating the antibodies in anti-pneumococcus serum. The concentrated antibody solution has been used with encouraging results in about sixty cases at the Boston City Hospital and in about sixty more in hospitals in New York and Brooklyn. Dr. Felton read a paper before the New England Health Institute in New York City on May 9 making public the methods and essential facts.

Dr. Felton's studies have dealt with the virulence of pneumococci, the pneumonia germs. He has sought to isolate the protective element in the serum taken from a horse immunized against pneumococci. The serum itself is weak and produces violent reactions in the form of chills, serum sickness, rashes, etc., which have radically diminished its value for the use of private practitioners.

While making studies with carbon dioxide precipitant, Dr. Felton observed that a very heavy precipitate was formed in the serum when diluted in plain water. Convinced that the substance carried with it the protective element of the serum and left behind the harmful substances, he tested it out with mice. He injected virulent pneumococci into a group of mice. After six hours he injected the new serum into some of the mice, while he allowed the disease to run its course with the others. At the end of thirty-six hours the controls had died of pneumonia. The mice protected by the serum recovered.

After further refinements of the serum, Dr. Felton distributed his product to a group of clinicians in hospitals in Boston, New York and Brooklyn, to be used for the benefit of those suffering from pneumonia. The encouraging results include the fact that the serum sickness and other harmful reactions have been practically eliminated.

The injections in human treatment are made intravenously. Subcutaneous injections, tried recently by scientists in the hope of escaping the harmful reactions of the old serum, were found to have little protective power. Dr. Felton's preliminary tests with other than Type I pneumonia indicate that it will not be difficult to have the same success with the other types of lobar pneumonia.

Added importance is given to the work by the probability that the isolation of the protective substance in pneumonia serum has brought to light a general law concerning the action of protective antibodies. "In addition to pneumococci, as a matter of control," Dr. Felton states, "it has been found possible to isolate the protective substance in immune sera developed by other micro-organisms. There are indications that the protective antibody of the pneumococcus is one of many which act in a similar fashion, and its behavior represents a general law for certain groups of bacteria."

Dr. Felton worked in the laboratory of Dr. Milton J. Rosenau, professor of preventive medicine and hygiene in the Harvard Medical School and chairman of the Influenza Commission of the Metropolitan Life Insurance Company. He went to Harvard in the fall of 1922 where he has been steadily at work on the mechanism of virulence. He is a graduate of Wooster College, Ohio, A.B., '10, and of the Johns Hopkins Medical School in 1916.

EXPEDITION TO THE VALLEY OF THE AMAZON

DR. CARL D. LARUE, of the department of botany of the University of Michigan, landed in New Orleans on March 14, after spending over eight months in different parts of the valley of the Amazon in Brazil and Bolivia, where, as specialist in rubber investigation, he has been studying the present status of the industry for the Department of Agriculture.

The objects of the expedition were as follows:

(1) The investigation of the present state of the industry in Brazil, including the extent of wild rubber and the methods of production.

(2) Study of the types of trees, particularly along the lower Amazon. The rubber-producing trees of the Eastern world, which now furnishes the greater part of the entire supply—the Malay States, India, Borneo, Ceylon, Java and Sumatra—were all originally transplanted from Brazil.

(3) Physiological studies of rubber trees, and botanical studies in general.

(4) Diseases of rubber-trees. This side of the work was in charge of Dr. J. R. Weir, pathologist of the Bureau of Plant Industry at Washington.

(5) An intensive study of conditions and methods of production in the Acré district on the Upper Amazon, where the best rubber is grown.

The results of the expedition will be published in Dr. LaRue's official report to the Department of Agriculture, now in preparation. The general results of the expedition were in all respects satisfactory.

PRIZES OF THE NEW YORK ACADEMY OF SCIENCES

THE New York Academy of Sciences announces two prizes of $200 and $100, respectively, offered by Mr. A. Cressy Morrison, fellow of the academy, to be known as the A. Cressy Morrison Prizes for 1924 and to be awarded at the annual meeting in December, 1924. The conditions are:

(1) Eligibility: Membership in good standing of the New York Academy of Sciences or one of the affiliated societies, prior to submission of the manuscript.

(2) Date: Papers are to be submitted on or prior to November 1, 1924, to the secretary of the New York Academy of Sciences at the American Museum of Natural History.

(3) Papers: The prize of $200 is offered for the paper adjudged to be the most meritorious in a field of science covered by the academy or an affiliated society, which paper embodies the results of original research not previously published. The prize of $100 is offered for the thesis adjudged to be most meritorious on the subject "What may be proved from our present knowledge as to the possibility or impossibility of released intra-atomic energy constituting an important source of solar and stellar energy."

(4) Awards: The awards shall be made by the council of the New York Academy of Sciences. At the discretion of the council, the prizes may be divided between papers adjudged to be of equal merit or both prizes may be awarded to a thesis presented for the $100 prize.

(5) Publication: The academy will consider publication of the successful paper or papers, but publication by the academy shall not be binding on either party.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

THE final program for the meeting of the International Union of Pure and Applied Chemistry to be held at Copenhagen, from June 26 to July 1, is definitely announced as follows:

Thursday, June 26.
3:30 p. m. Reception to delegates at the City Hall by the municipal authorities.

Friday, June 27.
9:00 a. m. Meeting of the council.
11:00 a. m. General assembly.
2:00 p. m. Meeting of committees.
8:30 p. m. Reception.

Saturday, June 28.
9:00 a. m. Meeting of committees.
1:30 p. m. Meeting of committees.
4:00 p. m. General lectures (to be announced later).

Sunday, June 29.
10:00 a. m. Excursions in neighborhood of Copenhagen and luncheon to delegates by the reception committee.

Monday, June 30.
9:00 a. m. Meeting of committees.
2:30 p. m. Visit to the Carlsberg Breweries, general lectures (to be announced later).

Tuesday, July 1.
9:00 a. m. Meeting of committees.
2:00 p. m. Meeting of council.
4:00 p. m. General assembly.
8:00 p. m. Banquet to the delegates by the reception committee.

During the course the delegates will be invited to a special lecture to be delivered by Professor Niels Bohr and will visit his laboratories in the Institute of Theoretical Physics of the University of Copenhagen.

The American delegation is composed as follows: Delegates to the Council: W. D. Bancroft, *Chairman*; J. E. Zanetti, *Secretary*; W. A. Noyes, W. T. Taggart. *Delegates to the Assembly:* E. J. Atkisson, F. E. Breithut, H. C. Fuller, H. C. Loudenbeck, R. A. Millikan and Atherton Seidell.

American chemists who expect to be abroad and who would like to attend the meetings are requested to communicate with Dr. J. E. Zanetti, chairman of the Division of Chemistry and Chemical Technology, National Research Council, Washington, D. C. Credentials from the National Research Council are necessary to attend these meetings.

THE SECTION OF MATHEMATICAL AND PHYSICAL SCIENCES OF THE BRITISH ASSOCIATION

OVERSEA members of the British Association for the Advancement of Science coming to the Toronto

meeting beginning on August 6, include the following:

Sir William H. Bragg, Quain professor of physics, London University, will deliver the presidential address before Section A on Monday, August 11, and will contribute to the joint discussion between Sections A and B on "Crystal structure."

J. H. Jeans, secretary of the Royal Society, formerly Halley lecturer in Oxford University, and professor of applied mathematics at Princeton, will speak on "Relativity."

A. S. Eddington, professor of astronomy in the University of Cambridge and director of the observatory, will also speak on "Relativity."

J. Jackson, from the Royal Observatory, and E. A. Milne, of the department of astrophysics of Cambridge, will speak on "Star motions."

Lord Rayleigh will speak on "The scattering of light."

R. H. Fowler, Trinity College, Cambridge, will speak on "Quanta."

J. W. McBain, professor of physical chemistry, University of Bristol, will take part in joint discussion on "Colloidal solutions" between the Mathematical and Chemistry Sections, and will also take part in a discussion on Photochemistry which has been arranged to take place at Saskatoon in the course of the western excursion.

G. I. Taylor, lecturer in mathematics in Trinity College, Cambridge, will take part in a joint discussion on "Aeronautics" between the Sections on Engineering and Physical Sciences.

Sir Napier Shaw, professor of meteorology at the Royal College of Science, and president of the International Meteorological Committee, will contribute to the program of the subsection of meteorology.

Harold Jeffreys, Cambridge, will contribute with L. F. Richardson, London, to the joint session in the subsection of meteorology.

E. T. Whittaker, professor of mathematics in Edinburgh.

A. O. Rankine, professor of physics in Imperial College of Science and Technology, recorder of Section A.

H. R. Hassé, professor of mathematics in the University of Bristol, one of the secretaries of Section A.

A. N. Tyndall, professor of physics, University of Bristol, secretary of Section A.

R. A. Giblett, one of the secretaries of Section A.

W. L. Bragg, Langworthy professor of physics in Victoria College, Manchester.

A. Fowler, professor of astrophysics, Royal College of Science, general secretary of the International Astronomical Union.

Sir R. T. Glazebrook, professor of aviation in the Imperial College of Technology, chairman of the Aeronautical Research Committee, recently director of National Physics Laboratory.

Major Percy A. MacMahon, formerly deputy warden of the standards, Board of Trade; general secretary of the British Association, 1902–14; president of the Royal Astronomical Society, 1917.

Sir Ernest Rutherford, professor of experimental physics and director of the Cavendish Laboratory, Cambridge University.

G. Udney Yule, lecturer on statistics, Cambridge University.

H. William Young, professor of pure mathematics, University of Wales.

Sir R. H. Rew, treasurer of the international statistical institute.

Vito Volterra, professor of mathematics and physics, University of Rome.

SCIENTIFIC NOTES AND NEWS

FOUR hundred and thirty British members have already signified their intention of attending the Toronto meeting of the British Association from August 6 to 13. During the meeting, popular lectures in the different sections will be given in the afternoon at 5 p. m., for members of the association. Several citizens' lectures will be given in the evening, as well as two or three lectures for children. The inaugural general meeting will be held on Wednesday, August 6, in the Convocation Hall of the University of Toronto. At this meeting Professor Sir Ernest Rutherford, F. R. S., will hand over the presidency of the association to Major General Sir David Bruce, who will then deliver his presidential address entitled "Advances made in the knowledge of disease with special reference to methods developed during the war."

AMONG eight busts unveiled in the colonnade of the Hall of Fame of New York University on May 13 were two of men of science. The bust of Joseph Henry, by Mr. John Flannagan, was presented by Mr. Edwin Wilbur Rice, Jr., on behalf of the American Institution of Electrical Engineers. It was unveiled by Mr. Thomas A. Edison and received by Colonel John J. Carty. The bust of William Thomas Green Morton, by Helen Farnsworth Mears, was presented by Dr. George David Stewart on behalf of the fellows of the American College of Surgeons. It was unveiled by Mr. Bowditch Morton, grandson of Dr. Morton, and received by Dr. William W. Keen.

DR. EDMUND BEECHER WILSON, Da Costa professor of zoology in Columbia University, has been elected a foreign member of the Paris Academy of Sciences, in the Anatomical and Zoological section, succeeding the late Dr. Jacques Loeb. Professor Wilson was elected on the first ballot, receiving 44 of the 47 votes cast.

THE gold medal of the British Medical Association has been awarded to Dr. Henry Britten Brackenbury for his distinguished services to the association and to the medical profession.

R. S. WILLIAMS, administrative assistant of the New York Botanical Garden, has been elected president of the Sullivant Moss Society.

DR. G. L. WENDT, formerly of the University of

Chicago and now director of research with the Standard Oil Company of Indiana, was recently elected chairman of the Chicago section of the American Chemical Society.

THE Anthropological Society of Washington announces the reelection of the following officers at the regular meeting of April 15: *President,* Truman Michelson; *Vice-president,* J. P. Herrington; *Treasurer,* J. N. B. Hewitt; due to the resignation of M. W. Stirling as secretary the Reverend John Cooper was elected to fill the vacancy.

J. C. PEARSON, who has been for more than twelve years chief of the cement section of the Bureau of Standards, has resigned to accept a position with the Lehigh Portland Cement Co., with headquarters at Allentown, Pa.

JOSEPH HYDE PRATT, who resigned on March 1 as director of the State Geological and Economic Survey of North Carolina, a position he had held since 1906, is now president of Western North Carolina, Inc., an inter-country association formed for the purpose of advertising and developing the resources and material and social possibilities of the mountain section of the state.

DR. FLORENCE B. SEIBERT has for the second time been appointed a research fellow of the William T. Porter Fellowship for physiological research administered under the auspices of the American Physiological Society. She will pursue her research work in the laboratories of Dr. H. Gideon Wells, at the University of Chicago.

DR. R. E. STRADLING, head of the department of civil engineering, architecture and building in the Technical College, Bradford, England, has been appointed director of research of the building materials and construction research board of the Government Department of Scientific and Industrial Research, London.

ENGINEER-CAPTAIN E. C. SMITH, R.N. (retired), who is well known as a lecturer and writer on the history of engineering, has been appointed guide-lecturer at the Science Museum, South Kensington.

DR. GEORG GOTTSTEIN, professor of surgery in the University of Breslau and director of the medical department of the Prussian ministry of public welfare, retired on April 1, on reaching the age limit.

DR. ARTHUR W. GILBERT, Commissioner of Agriculture in Massachusetts, from 1911 to 1917, professor at Cornell University, was appointed by the Secretary of State to head the American delegation to the meeting of the general assembly of the Institute of Agriculture, which was held in Rome on May 2.

PROFESSOR ARTHUR A. ALLEN, of Cornell University, who is now absent on leave, is completing a five-weeks' study of the bird life around Houston, Texas, Galveston Island, in the Gulf Coast district. He reports that he has found seventy kinds of birds not found in New York, his entire list including 144 species.

GERRIT S. MILLER, JR., curator of the division of mammals of the National Museum, left Washington in April for a visit to some of the islands of the Lesser Antilles. Dr. Miller expects to make collections of the flora and fauna of the islands.

H. C. FULLER, of the Institute of Industrial Research, Washington, D. C., sailed for Europe on May 3. He expects to spend about two months in France and Italy and will attend the Fourth Congress of Industrial Chemistry at Bordeaux on June 15, as a delegate from the American Chemical Society. He will also attend the International Union of Pure and Applied Chemistry at Copenhagen from June 26 to July 1, as a representative of the National Research Council.

PROFESSOR H. H. WHETZEL, of Cornell University, and Dr. F. D. Kern, of the Pennsylvania State College, will make in June a mycological collecting trip to Porto Rico. An effort will be made to cover those parts of the island not before touched by mycologists, and the results will be available for the "Botany of Porto Rico and the Virgin Islands" being prepared by the New York Botanical Garden and the New York Academy of Sciences.

SIR D'ARCY POWER, consulting surgeon, St. Bartholomew's Hospital, London, and vice-president of the Royal College of Surgeons, recently arrived in the United States to take the place of exchange professor in the Medical School of Harvard University. On April 21, he addressed the Boston Medical History Club.

DR. THOMAS HUNT MORGAN, of Columbia University, delivered on May 9 the ninth Mellon lecture before the school of medicine of the University of Pittsburgh, on "Human inheritance."

DR. SAMUEL W. STRATTON, president of the Massachusetts Institute of Technology, will deliver the Phi Beta Kappa oration at the commencement exercises of Harvard University.

DR. EDMUND C. SANFORD, head of the department of psychology at Clark University, will deliver the commencement address on June 16.

DR. H. A. SPOEHR, of the laboratory of plant physiology of the Carnegie Institution, gave an illustrated lecture in Washington on May 1, entitled "Sunlight, the prime-mover of civilization."

THE following public lectures were given on May 2,

9 and 16, under the auspices of the Department of Physics of Harvard University: "The modern steam locomotive," Professor Harvey N. Davis, consulting engineer, U. S. Bureau of Mines, since 1921; "Vibrations on high frequency with application of radiotelegraphy," with demonstrations, by Professor George W. Pierce, director of the Cruft High Tension Electrical Laboratory; "Electricity in illuminations," by Professor Harry E. Clifford, Gordon McKay professor of electrical engineering in the university.

At the celebration of the jubilee of the Physical Society of London, Sir Richard Paget delivered a lecture arranged by the Society of Electrical Engineers on "The Nature of Speech."

The Oliver-Sharpey Lectures at the Royal College of Physicians of London were given by Professor A. V. Hill, F.R.S., of University College, London, on April 29 and May 1. The first lecture was on the recovery process in the isolated muscle, and the second on the recovery process in man.

Dr. F. W. Aston, fellow of Trinity College, Cambridge, is to deliver the annual address before the Institute of Metals on June 4. The subject will be "Atoms and Isotopes."

Sir William M. Bayliss, professor of general physiology in University College, London, has been elected a corresponding member of the Royal Academy of Medicine, Brussels.

A special meeting in memory of the late Dr. Paul Ehrlich, on the seventieth anniversary of his birth, was held in the Kitasato Institute for Infectious Diseases, on March 14, under the auspices of Dr. S. Hata and Baron Kitasato, coworkers with Ehrlich.

Heinrich O. Hofman, professor emeritus of mining and metallurgy at the Massachusetts Institute of Technology, died on April 28, at the age of sixty-six years.

Lindon Wallace Bates, engineer of Mt. Lebanon, N. Y., who is known for his work on waterways, died in Paris on April 22.

Prince Roland Bonaparte, for many years president of the French Geographical Society and a free member of the Paris Academy of Sciences, died on April 14, aged sixty-five years.

Dr. Nelson Annandale, director of the Zoological Survey of India, died in Calcutta on April 10, aged forty-eight years.

Professor G. A. J. Cole, F. R. S., professor of geology at the Royal College of Science for Ireland and director of the Geological Survey of Ireland, died on April 21, aged sixty-four years.

Major Francis William Cragg, the well-known entomological expert, who had been investigating typhus and relapsing fevers, recently left Kasauli for Lahore, where typhus is prevalent, in order to study the disease. He contracted the disease himself and died on April 23. For some time past Major Cragg had been assistant director of the Central Research Institute at Kasauli.

Dr. Norman Bridge has subscribed $150,000 to a fund of three million dollars which is being collected for the Southwest Museum of Art, Los Angeles.

It is planned to establish a national academy of pharmacy representing the American Pharmaceutical Association, the National Association of Retail Druggists', the National Wholesale Druggists' Association, the American Pharmaceutical Manufacturers' Association, the American Drug Manufacturers' Association, the American Conference of Pharmaceutical Faculties, the National Association of Boards of Pharmacy and the Proprietary Associations. A provisional charter has been granted by the State of New York. It is planned to erect a three-story building, which shall be the home of the drug profession. The structure will contain a complete library, a research laboratory, a staff of pharmaceutical technicians, legal experts to scrutinize legislation and an employment bureau.

Studies are being made of Indian psychology, covering intelligence, achievement, will-temperament, musical talent and color preference, by the Bureau of Educational Research of the University of Denver, under the auspices of Dr. Thomas R. Garth. This spring, three expeditions have been sent out, one investigation conducted by a graduate student at Chilocco, Oklahoma, another in Santa Fé and Albuquerque and the third on the Ute and Navajo reservations in Colorado and New Mexico.

A telegram from Dr. Philip S. Smith, of the U. S. Geological Survey, who is in charge of the expedition which left the northern outpost of Alaska at Tanana on February 17, has been received by the Interior Department, having been relayed by team drivers. The message, which was dated March 29, states that passes through the mountains into the northern Arctic drainage and location of the headwaters of rivers in the Northern Alaskan wilderness embraced within Naval Petroleum Reserve No. 4 have been discovered. The party planned to descend from the headwaters of newly located rivers in canoes when the ice breaks up. On the date of the message, the party was exploring the region near the northern limit of timber north of the Arctic Mountains and extending their surveys down the Colville River.

THE annual report of the Zoological Society of London, just received, shows that the society is proceeding with the publication of volume 59 (for 1922) of the *Zoological Record*, and has arranged for the compilation of the materials for volumes 60 and 61 (literature of 1923 and 1924). The society is willing to lose as much as £500 a year on the undertaking, but further losses must be made up in other ways if the service is to be continued. The donations received up to December 31 amount to £624. 3s. 4d., of which £150 is contributed by the British Museum of Natural History, £100 by the Royal Society, £50 each by the British Association and the Entomological Society of London, and smaller amounts by other societies and individuals. The largest amounts from America are £25 from Mr. T. Barbour, of the Museum of Comparative Zoology; £22. 4s. 6d. from the University of Michigan; £23. 0s. 4d. from the Academy of Natural Sciences of Philadelphia; and £16. 0s. 0d. from the Entomological Society of America. The Zoological Society has made a donation of £100 to a fund for the purchase of the Farne Islands as a permanent sanctuary for birds.

WE learn from the *Journal* of the American Medical Association that a recommendation that a general health survey of Philadelphia be made "as a necessary preliminary to the sesqui-centennial celebration" was made April 1 to the public health administration section of the American Public Health Association in a report presented by Murray P. Horwood, assistant professor of biology and public health at the Massachusetts Institute of Technology. He has made an exhaustive study of health conditions in Philadelphia and in the report includes thirty-one recommendations for improvement in city methods of fighting infectious diseases. The sesqui-centennial health survey is intended to eliminate the possibility of contagion to the hundreds of thousands of visitors who are expected to visit Philadelphia in the summer of 1926.

ADOPTION of metric units of weights and measures in merchandising will be a topic of discussion before the convention of the Chamber of Commerce of the United States, to be held at Cleveland in May. On May 5 the metric issue will be prominent, the national council being called upon to advise whether the pending metric referendum shall be submitted to nationwide vote of American business organizations. A year of study and conference was devoted to world standardization by the metric committee of the Chamber of Commerce of the United States, and its report will be the basis of the vote. Japan and Russia in 1921 adopted metric units for commercial use, and China is also gradually standardizing on the metric measures. All the civilized world is now on the metric basis, except the United States and the British Commonwealths. The Congress of Chambers of Commerce of the British Commonwealths voted overwhelmingly for adoption of the metric units, and American business men are expected to do likewise.

THROUGH the generosity of the Association of Apparatus Makers of the United States, the *Journal of the Optical Society and Review of Scientific Instruments* announces a prize of $250 for the best paper on scientific instruments and methods presented between May 1 and December 31, for publication in the instrument section of the journal. The *Journal* publishes in the instrument section original articles describing new instruments or new methods for research or instruction in any branch of science such as physics, chemistry, astronomy or biology. The prize will be awarded by a committee to be appointed by the National Research Council. Manuscripts should be sent to the following: Paul D. Foote, editor-in-chief, Bureau of Standards, Washington, D. C., or F. K. Richtmyer, managing editor, Rockefeller Hall, Ithaca, N. Y.

ON account of the conflict between the meeting of the next (Fourteenth) International Geological Congress, to be held at Madrid in the spring of 1925, and the meeting of the Geographic Congress which is to take place in Cairo at the same time, the Spanish government has decided to postpone its entertainment of the International Geological Congress until the spring of 1926, when the geologists will be convened in Madrid by invitation of the Spanish government.

A CORRESPONDENT writes: "Mr. E. B. Starr, manager of the Celite Company at Lompoc, California, lately discovered a skeleton of a huge animal embedded in the Miocene diatom deposits. This was secured for Stanford University by Eric Jordan and William Olmstead, students in geology. The skeleton seems to be that of an extinct sea-cow, probably new to science. It is 14 feet long, with a small, hard head, and great ribs, three inches in diameter."

UNIVERSITY AND EDUCATIONAL NOTES

THE Rockefeller Institution has offered, subject to the consent of the municipal council, to build and thoroughly equip a laboratory for the school of physiology and biology of the University of Copenhagen, under the direction of Professor August Krogh.

PRESIDENT KENYON L. BUTTERFIELD, of the Massachusetts Agricultural College, has for the second time been offered the presidency of the Michigan Agricultural College.

DR. W. W. CHARTERS has been appointed dean of the graduate school of the University of Pittsburgh. Professor J. F. L. Raschen, at his own request, has been relieved of the executive work of the graduate school, which he has carried for the past seven years.

DR. W. K. GREGORY, of the American Museum of Natural History, has been made professor of paleontology in Columbia University.

DR. JOHN HINCHMAN STOKES, head of the section of dermatology and syphilology at the Mayo Clinic, Rochester, Minn., has been elected to the professorship of dermatology in the Medical School of the University of Pennsylvania.

THE department of entomology at the University of Kansas has been reorganized, with Dr. H. B. Hungerford as head and also state entomologist for the southern half of the state. Other members of the department are Dr. Paul B. Lawson, Mr. Philip A. Readio, Mr. R. H. Beamer and Miss Kathleen Doering.

DR. LOUIS K. OPPITZ, of Howard College, Birmingham, Ala., has been elected professor of physics at Colorado State Teachers College, Greeley, Colo. During the coming summer Dr. Oppitz will teach physics at Baylor University, Waco, Texas.

DR. OTTO MEYERHOF, associate professor of physiology at the University of Kiel, who was recently awarded the Nobel prize in medicine for his work on muscles, has been called to Berlin.

DR. PAUL SCHERRER, professor of physics in the Zurich Technical School, has been called to the University of Bern as successor to Professor A. Forster.

DISCUSSION AND CORRESPONDENCE

MAGNETIZATION CURVE, NAMES FOR ITS PARTS

THE magnetization or B–H curve of iron (see Fig. 1) is used and discussed by physicists and engineers so much that its different parts deserve separate names. At the present time the "knee" is the only recognized term in several languages, and the other parts are only referred to descriptively as "below the knee," "above the knee," "on the saturated part," etc. In writing or speaking about this curve I have felt at times handicapped by such a lack of recognized terms, and I propose to call the remaining parts of the curve in accordance with the common names for the parts of the human lower limb, namely, the *foot*, the *instep*, the *leg* (or lower leg), and the *thigh*. The names "leg" and "thigh" can also be used for the corresponding parts of a saturation curve of an electric machine, for the parts of a mechanical stress-strain diagram below and above the elastic limit, etc.

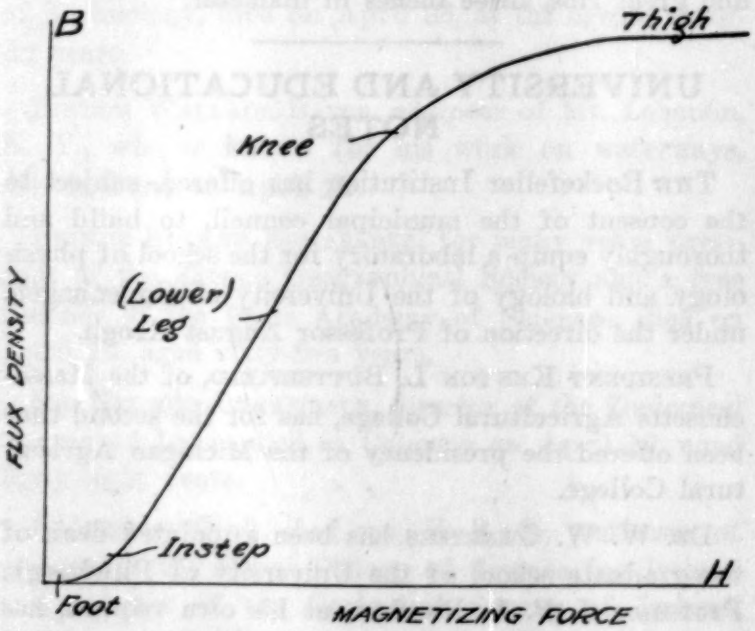

FIG. 1

The only objection to such terms is that they have to be different in each civilized language, and it may be preferable to give them the corresponding Latin or Esperanto names. This will also meet the objection of some older people about mentioning lower limbs in society.

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THE LEARNING CURVE FOR A SNAIL

YERKES trained an earthworm to go through a T-maze made of glass some twelve years ago. Miss Mary Pinkney Mitchell, a student in the educational psychology laboratory of University of Denver, working under the direction and guidance of the writer, has now trained a land snail, *Goniobasis pleuristriata* Say, for three months, using some three trials a day. The apparatus is a glass T-maze somewhat similar to that of Yerkes, the drive used is light from a 75-watt Mazda lamp. Hibernation of the snail was prevented by keeping it in an improvised incubator.

The training of the snail was begun December 3, and is being continued. The average time for the first five trials in the maze was 857 seconds, and for the last five trials to date is 316 seconds. The total errors for first five trials were 4, and there are now no errors made at all. In all there have been 102 trials made by the snail. There are of course fluctuations in the time curve, but there is a positive tendency for the time to decrease with successive trials so that the smoothed-out curve indicates learning of a more or less permanent character.

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SCIENTIFIC BOOKS

Social Psychology. By FLOYD HENRY ALLPORT, associate professor of psychology, University of North Carolina. Houghton Mifflin Co. Pp. viii + 453.

OF late years there has been some tendency to con-

ceive psychology as concerned with the environmental adaptations of the organism as a whole. Among human beings, at least, a most important feature of the environment consists of other human beings. Adaptations in this sphere are readily conceived as social psychology, and thus the term becomes fairly synonymous with psychology itself. The present book, by one of the outstanding figures among the younger American psychologists, is substantially a general psychology as it would be written by a close student of psychology from the above angle. No general text has been produced in an academic setting, with which persons concerned in these applications of psychology are likely to find themselves in such immediate touch.

This is the book's conspicuous achievement. Much of human nature is here brought closer to systematic psychology than it has yet been. It does not follow from this that the author is primarily a systematist. His concern is for observation rather than formulation. The differences of behaviorism and mentalism mean hardly more to him than to the reviewer (p. 3). With regard to the instinct discussion he takes a practical view similar to one recently elaborated by Dunlap (p. 80). His use of "prepotent" is distinctive and serviceable. Among the weightier passages of the book is also the paragraph which heads p. 410.

No one could cover Allport's ground without dealing with many matters unsettled, and the subjects of more or less intense disagreement. His colleagues are likely to disagree at various points, perhaps not more with him than with each other. In matters of this kind Allport adopts definite and not ill-considered teaching, discussing opposing views, as concerning the maturation of instincts, or tending to pass over them, as with regard to the emotions. For general teaching purposes, it would indeed be an ambitious matter to balance these issues extensively; the reference lists given are broad and well selected.

The reviewer finds himself in close accord with the essence of the book; but this perhaps creates the more necessity for noting points which it seems difficult to accept. It is also true that in the intellectual as well as the digestive sphere, it is disagreements that obtrude themselves more coercively upon the mind. Among such more apt starting points for discussion might be mentioned the primacy ascribed to the autonomic functions (*e.g.*, p. 37); the discounting of the mechanism of sublimation (p. 75); the summary dismissal of inherent "resistance" in the behavior of modesty (p. 54). Psychologizing on the basis of "primitive" language is skating on thin ice (p. 191). And when, on p. 398, it is said that "contemporary sociologists are unanimous in their plea for the socialization of government, and for rendering its control positive and constructive rather than purely prohibitive," one wonders if there has not stirred into function the very mechanism deprecated on p. 309.

The content of the book is broad enough for an elementary course, and it may have been with this in mind that some of the first part was included. The material given on the nervous system, for example, is something which the student might more traditionally look for elsewhere and would probably meet in the regular introductory presentation. The book as a whole, however, is rather closely packed with detail for an introductory work. Allport's style is always elegant without being florid; but one questions how easy reading it will be to the undergraduate, or even to the cultivated non-technical reader. It seems a book to be studied rather than read, well adapted for teaching, out of which it presumably grew, but more so for relatively advanced students.

Of two points raising special questions in the mind of the reviewer, the first, mentioned above, concerns the emotions. Few will dispute the care and ingenuity with which the theory is constructed; but the foundation on which it rests—visceral reactions—is one that certain close students of the process have become reluctant to trust. One looks for some disposition of objections raised from more than one authoritative source. It is an open question if any theory of emotion based on autonomic (vegetative) response stands the test of contemporary experience.

The other point concerns introversion and extroversion, as Allport and some other Americans write it. The orthographic distinction made with extraversion (p. 117) seems a little factitious—the two forms are used side by side in psychology, much as are tactile and tactual. Their meanings, however, are still in a fluid state. The two words have been useful mainly from a certain picturesqueness, which drew attention to various interesting differences of reaction-type. The consideration would bear more emphasis that such concepts do not denote disparate groups, simply more or less recognizable degrees of reaction-type in particular settings. There has of late been a psychiatric trend away from the earlier meaning of introversion (emphasizing the passive component) which is represented in the volume. Extraversion, similarly, takes on more of the simply "allocentric" meaning, dispensing with the original significance of activity. These more recent distinctions suggest those made by James between the entrenched and the inclusive "me" ("Principles," I, 312–313). The former reaction type would be symbolized in the remark attributed to Thackeray, "Madam, I don't read books, I write them." His followers also review them sometimes.

F. L. WELLS

THE NATIONAL ACADEMY OF SCIENCES

THE scientific program of the annual meeting of the National Academy of Sciences, held in its new building in Washington, from April 28 to 30, together with abstracts of part of the papers, was as follows:

Radio fog signals for the protection of navigation: G. R. PUTNAM (introduced by HERBERT HOOVER). An important new application of radio in safeguarding navigation has come into practical use within the last three years. Radio signals are sent automatically from lightships and lighthouses, and bearings are taken with the radio compass on shipboard. The first successful radio fog signals were those established in the United States in 1921. The paper gives a summary of the present state of these applications of radio, and also describes recent tests made of tube transmitters for radio fog signals, and of the so-called night effect as affecting the use of radio bearings under this system.

A suggestion for a portable gravity meter: E. E. WRIGHT. Repeated efforts have been made to replace the slow and costly dynamic pendulum methods for the measurement of gravity by static methods in which the earth's pull is determined in terms of the elastic deformation either of a solid by torsion and bending or of a gas by compression. These methods have thus far not proved satisfactory because they have failed to give the required degree of accuracy, namely, one part in a million. The conditions to be met by a static gravity meter intended for use in the field are portability and simplicity of operation coupled with high sensitivity and precision of measurement; in addition certain other factors, such as lack of perfect elasticity of available materials, change in their rigidity modulus with change in temperature, and vibrations due to earth tremors are disturbing and have to be considered in the design of a suitable apparatus. Preliminary tests on a new gravity meter which consists essentially of a spring of silica glass or of tungsten wire tapering from each end toward the center at which point a short lever arm is attached at right angles to the spring. Each end of the spring is attached to the axis of rotation of a framework on whose rotation the cross lever arm is gradually raised to a horizontal position; the angle of rotation necessary to raise the cross arm from the one horizontal position to the second is read off directly on a graduated circle; the position of horizontality in each case is observed with the aid of an autocolimating telescope system sighted upon a small plane parallel mirror attached to the cross arm. The tapering springs and cross arm together constitute an aperiodic vibrating system in which all oscillatory movements are quickly damped out. The influence of temperature is either maintained constant by means of an ice packing or an empirical correction is made for it. With this instrument, which is free from friction, any degree of sensitivity can be attained by proper selection of tapering springs and lever arm.

An explanation of the gaps in the distribution of the asteroids: ERNEST W. BROWN.

Allegheny results on the shift of the solar lines predicted by the theory of relativity: HEBER D. CURTIS. A program of more precise determination of solar spectrum wave-lengths has been inaugurated at the Allegheny Observatory, in cooperation with the Bureau of Standards. The work is being carried on by Dr. Burns and Director Curtis, of the Allegheny Observatory, and by Dr. W. F. Meggers, of the Bureau of Standards. In its essentials, it is a continuation of Rowland's work with more modern methods; by a curious coincidence assistance has been received for this work from the same fund of the National Academy, the Bache Fund, from which assistance was given to Rowland's work over thirty years ago.

The method used is a combination of an interferometer with a powerful grating spectrograph; while this method has been used to some extent in studying the spectra of individual elements, this is the first time it has been applied in a systematic and extended program of precision work on the solar spectrum. The method is capable of very high accuracy, the resulting wave-lengths being true within one part in five to one part in eight million.

While the primary purpose of this work at the Allegheny Observatory is a more accurate knowledge of the solar spectrum, a number of very interesting by-products are already in evidence. Perhaps the most interesting of these secondary products of the research is that which has to do with the minute shifts of the spectrum lines of the sun to the red, as compared with the positions of the same lines in luminous sources on the earth.

It will be remembered that one of Einstein's predictions as a result of his theory of relativity was that any light originating in a powerful gravitational field should have its spectrum lines shifted very slightly to the red. In the case of the sun, light emanating from its surface should by Einstein's theory be shifted a very minute amount toward the red end of the spectrum; the shift is only about eight thousandths of an Angrostöm unit, which amounts roughly to two one-millionths of the wave-length.

The Allegheny measures can detect wave-length variations ten or more times smaller than this predicted shift, and the results of the measures made by Dr. Burns and Dr. Meggers show shift features very different from the simple and uniform amount predicted by the relativity theory. Instead of all the solar lines being shifted by an equal amount to the red, and that amount the quantity predicted by Einstein's theory, a very marked line-intensity factor is found. That is, for the very faint solar lines there is little, if any, shift, and the amount of this shift increases as the wider and stronger lines are used. The following short table illustrates the main features of the Allegheny results:

INTENSITY OF SOLAR LINE	SHIFT TO RED
0 (very weak)	A .002
1	.002
2	.003
3	.005

4	.006
5	.008
Einstein's prediction	.008
6	.009
8	.012
10 (strong)	.015
15 (very strong)	.015

There is thus seen to be an unmistakable progression in this shift, which must be due to some factor or factors other than relativity, and it does not seem possible to reconcile these results with that theory. For the theory requires that all solar lines be shifted to the red by a certain amount, while our results show that the very weak solar lines are shifted only one quarter or less of that amount. That is, if the relativity prediction is true, we must postulate some cause to shift the very weak lines back toward the violet. Now, while various causes may shift spectrum lines to the red, there is no known case of anything shifting them to the violet, except velocity, which seems untenable in this case. Accordingly the authors regard these results as a negation of one of the so-called proofs of the theory of relativity.

Gravitational influence of spectral lines: CHARLES E. ST. JOHN (introduced by J. C. Merriam).

The spectrohelioscope: GEORGE E. HALE (by title).

Joining the infra-red and electric wave spectra: E. F. NICHOLS and J. D. TEAR. A brief account of the work of previous investigators in this field is given. A new type of electric wave receiver and echelon analyzer for short electric waves is described, together with an improved form of short wave generator. Improvement in apparatus and method of observation has enabled the writers to generate and measure electric waves shorter than the longest heat waves emitted from hot bodies. Two varying types of the new radiometric electric wave receivers have been used to remeasure long heat waves giving results identical with those obtained by earlier investigators with the usual infra-red equipment. The paper offers a further experimental proof of Maxwell's electromagnetic theory of light and provides instrumental equipment for the intensive study of a large and hitherto unexplored region of the spectrum. Finally, the electromagnetic spectrum considered as a whole extending from radio waves down to the shortest gamma rays of radium is briefly discussed.

The spectra of helium in the extreme ultra-violet: THEODORE LYMAN. The chief points to be presented are: First, the confirmation of the discovery of the first ultra-violet enhanced series of helium $4N\left(\frac{1-1}{2^2\ m^2}\right)$. second, the discovery of the first two members of the extreme enhanced series $4N\left(\frac{1-1}{1^2\ M^2}\right)$; third, the extension of the oS — mP arc series to a total of seven terms; fourth, the discovery of a line at the X 591.5 of the type oS — 1p, interesting because it is the first experimental evidence for radiation from helium involving a so-called intersystem combination, that is to say, a jump from a doublet energy level to the fundamental singlet level; fifth, the discovery of a continuous spectrum extending beyond the limit of the oS — mP series.

The paper also contains results on the study of the behavior of diffraction gratings in the extreme ultra-violet, and a brief discussion of a new type of vacuum spectroscope.

New stars in the light of their spectral behavior: W. H. WRIGHT.

Star radiation temperatures and diameters: C. G. ABBOT.

Secondary and tertiary radiations: WILLIAM DUANE.

Stellar statistics: C. V. L. CHARLIER (introduced by A. O. LEUSCHNER).

A statistical discussion of sets of precise astronomical measurements: proper motions: EDWIN B. WILSON and WILLIAM J. LUYTEN.

Relativity and the rotary motion of a spiral nebula: OSWALD VEBLEN.

The application of radio engineering principles to submarine telegraph cables: GEORGE O. SQUIER.

Proper motions in selected areas: PHILIP FOX and FRANK SCHLESINGER. This paper deals with photographs secured by Professor Fox, at Dearborn Observatory, and measured and reduced at Yale University Observatory. They were originally intended for the determination of parallaxes and proper motions in certain of the selected areas. The results indicate that while such observations do not yield sufficiently accurate values of the parallaxes they give good proper motions. To determine many parallaxes on the same plate with sufficient accuracy it will probably be necessary to introduce some device for equalizing the apparent intensities of the star images.

Biographical memoir of George F. Becker: G. P. MERRILL.

Biographical memoir of W. G. Farlow: WILLIAM A. SETCHELL.

Biographical memoir of Alfred G. Mayor: C. B. DAVENPORT.

Biographical memoir of Edward W. Morley: F. W. CLARKE.

Biographical memoir of Wallace C. W. Sabine: EDWIN H. HALL.

Biographical memoir of Edward Emerson Barnard: E. B. FROST.

Electronic orbits in stripped atoms (illustrated): R. A. MILLIKAN.

Optically excited mercury atoms: An experimental proof of the Bohr theory: R. W. WOOD.

The derivation of electro-magnetic fields from a basic wave function: H. BATEMAN and B. EHRENFEST (introduced by R. A. MILLIKAN).

The basic wave-function W being represented in Minkowski's world by the inverse square of the distance between two points S and P, a logarithmic wave-function V may be obtained by integrating W along a weighted world-curve Q, which is the locus of S, between two

points A and B which may be joined to P by broken light-lines AGP, BHP with turning points G and H, respectively, on curves C and T close to Q.

When V is used as one component of a Hertzian vector a field is obtained in which radiated electric dipoles are gradually extinguished. If C and T are varied by using infinitesimal rotations in the Minkowski world, six wave-functions are obtained which can be used as components of the field-vectors in a fundamental type of electromagnetic field. Superposition leads to a field in which the charge associated with a moving point fluctuates on account of the emission of simple charges and from this field one may derive a field in which dipoles oriented perpendicular to the rays travel without change of movement and the terms of order (1/r) are finite everywhere.

Atomic collisions: W. D. HARKINS and R. W. RYAN.

Researches in the terephthalic acid group: MARSTON TAYLOR BOGERT. Terephthalic esters, prepared from the waste "spruce terpentine condensate" of the paper mills, are being investigated as possible sources of new and useful drugs and dyes. Compounds structurally related to certain hypnotics and local anesthetics have been prepared, as well as dyes of malachite green type.

Newly discovered properties of permalloy and their theoretical bearing: H. D. ARNOLD (introduced by F. B. JEWETT). It has been found that permalloy, under certain conditions, has its permeability greatly increased by tension, and attains practically complete magnetic saturation in a field of as little as 0.1 gauss. At the same time hysteresis almost vanishes. These and related results have led to a modification of the theory of ferromagnetism in which internal mechanical strain becomes of prime importance.

New invariant forms in a cyclic three-to-three relation: H. S. WHITE. Cyclic binary correspondences (3.3) of period 7 are known since 1915 (our Proceedings, vol. 1.) Seven points or values of x determine the relation, and from them are fixed definitely seven values of y. But the correspondence is neither through circular nor through elliptic functions, and the algebraic details have not been worked out hitherto. I show how the equation is completely determined by the seven values of x in assigned order; I deduce 28 new invariants of the one set equal to 28 corresponding but not similar invariants of the other set; I show how five of these invariants determine by linear equations the cycle of seven values of y from those of x. This determination leaves still free, of course, three parameters of a linear transformation.

Prime power substitution groups whose conjugated cycles are commutative: G. A. MILLER. Main theorem: The subgroup composed of all the substitutions which omit one letter of such a transitive group must be cyclic.

Analytical solutions in Leuschner's method of deriving preliminary orbits of disturbed bodies (illustrated): RAYMOND HENRI SCIEBERETI (introduced by A. O. LEUSCHNER).

The orbits and general perturbations of the Watson planets (168) Sibylla, (94) Aurora, (79) Eurynome and (150) Nuwa: A. O. LEUSCHNER and H. THIELE.

Carnotite and tyuyamunite and their ores in Colorado and Utah: W. F. HILLEBRAND. The paper embodies the results of occasional research during a period of over twenty years since the author's first publication on carnotite and associated minerals in collaboration with F. L. Ransome. The ores contain principally two distinct hydrous uranium-vanadium minerals—namely, carnotite and tyuyamunite. In the first, potassium is the main if not only monoxide-base metal; in the second, calcium. The ratios of the constituents are the same except as to the water. Carnotite fully hydrated has probably not more than two molecules of water, tyuyamunite probably more than eight. In both the water content is much dependent upon the humidity of the surrounding air. Carnotite does not melt at a red heat, tyuyamunite melts readily. Other associates are malachite, azurite, vanadates of barium and copper, a hydrous potassium-aluminum-vanadium silicate, some undetermined molybdenum compound, etc. A statement by Dr. Merwin summarizes what little is known of the optical properties. Owing to the physical character of carnotite and tyuyamunite, optical examination helps little to differentiate them. Analyses of very nearly pure material of both carnotite and tyuyamunite from Colorado and Utah, respectively, and of tyuyamunite from Fergana in Asia were made. Notwithstanding great similarity, the minerals are probably not isomorphous. Tyuyamunite may belong to the uranite or autunite group, but the low water content of carnotite seems to forbid similar placing of that mineral. The potassium of carnotite can be replaced by calcium and the calcium of tyuyamunite by potassium. In undergoing these transformations the water content changes also to or toward that of the other mineral. It is suggested that in nature tyuyamunite is now being formed from carnotite. The transforming salts appear to exercise a selective action, and, if so, a way is indicated by which it may be possible in some cases to determine whether a given material is a homogenous mineral or a mixture of minerals, when optical tests and quantitative analysis fail to do so.

Actual shifts of mass on or in the earth's crust, and their geological effects as deduced from the doctrine of isostasy: A. C. LAWSON (introduced by J. C. MERRIAM).

An uptilted, beveled-off atoll: W. M. DAVIS. If an atoll were uptilted by deformational forces and beveled off by degradational forces, its understructure would be well revealed. If the atoll had been formed by reef upgrowth and lagoon aggradation over a slowly subsiding foundation, according to Darwin's theory, its revealed understructure would give clear indication of such formation. An island will be described in which various rock structures—volcanic below, limestones with reef-building corals and other shallow-water fossils above—are inclined at an angle of about 15° and beveled off in moderate or low relief. In so far as the structures are revealed, they correspond closely with the structures expectable under Darwin's theory. The total thickness of the exposed section is about five times the depth of the boring made in the reef of the Funafuti atoll in the Pacific.

Some recent studies of rock forming algae: MARSHALL A. HOWE.

A theory of emulsions produced by oleate soaps: WILLIAM D. HARKINS and E. B. KEITH.

Scientific background for the forest policy of the United States: W. B. GREELEY (introduced by J. C. MERRIAM).

Historical tradition and Oriental research: J. H. BREASTED.

Present status of investigations concerning antiquity of man in California (illustrated): JOHN C. MERRIAM.

A recent discovery of ancient human remains in Los Angeles, Calif. (illustrated): CHESTER STOCK (introduced by J. C. MERRIAM).

Fossil men and fossil apes of Europe (illustrated): ALES HRDLICKA.

Paleontologic discoveries in Mongolia by the Third Asiatic Expedition of the American Museum of Natural History: HENRY FAIRFIELD OSBORN.

The influence of alcohol on duration of life: RAYMOND PEARL. In this paper are presented for the first time complete life tables, calculated in precisely the same manner that all insurance life tables based upon the actual experience of the insured are calculated, which give critical evidence on the influence of the use of alcohol as a beverage upon the duration of human life. The data include exact records as to the drinking habits of thousands of persons throughout their lives. The experience includes over 150,000 person-years exposure to risk. Comparison with the official United States life tables shows that the experience dealt with in this study is actuarially entirely normal. That is the persons included in it are not significantly super-standard or sub-standard life insurance risks. They are just normal, average people. The results demonstrate that moderate, steady drinkers have a better expectation of life at all ages from age 30 on to the end of the life span than do total abstainers. The differences are not very great, but there is a distinct and well-marked advantage in favor of the moderate steady drinkers. Heavy drinkers have the poorest expectation of life at all ages after 30 in the case of females, and at all ages after 30 and up to about 65 in the case of males. From about 65 on the heavy drinking males and the total abstaining males have about the same expectation. These conclusions are drawn from what is demonstrably the most critically adequate material, considering both quality and quantity, which has ever been available for the study of the problem of the influence of alcohol upon the duration of human life.

Further report on experiments in epidemiology: SIMON FLEXNER and LESLIE T. WEBSTER. On two previous occasions reports to the academy were made on an experimental study of epidemics among mice induced by microorganisms of the mouse typhoid group. The disease consists of an intestinal infection which later, and before death ensues, becomes general throughout the body as the bacillus is present in the blood and organs at autopsy.

The purpose of the study was the determination of the manner of spread of the diseases among a mouse population previously unexposed and unaffected. An experimental mouse village having been arranged, the infection was started purposely and the precise mode of spread observed and recorded.

Several factors are now recognized as affecting the spread of the disease. First, by keeping the dosage and host susceptibility factors constant, it has been shown that the mouse typhoid bacilli differ among themselves in virulence, some being potentially able to incite an epidemic while others are relatively harmless, but that the virulence of any given strain is relatively constant, unaffected by animal passage and environmental conditions before, during or after an epidemic. Furthermore, by keeping the bacterial virulence and host susceptibility factors constant it is found that the severity of an epidemic, as judged by the per cent. of mortality, is a direct function of dosage, or quantity of bacilli available to each individual. And finally, by keeping both microbic virulence and dosage constant, it has been shown that, given a massive dose of virulent bacilli, universally distributed throughout any population, the number of individuals infected and the duration of life of those which die depend upon the resistance of the individuals in the community. The degree of this resistance is expressed by the reaction of the animal to the bacilli; the most resistant become healthy carriers, those more susceptible develop infection and recover, and those most susceptible succumb to the infection after varying intervals of time. This resistance has been shown to consist of a non-specific general immunity, markedly influenced by heredity and environment, plus or minus a certain degree of acquired specific immunity. Evidence of specific immunity may be found throughout many laboratory mouse populations by a demonstration of mouse typhoid carriers as well as individuals with specific serum agglutinins. Different degrees of non-specific general immunity are found in various races of mice, and it has been ascertained that selective breeding increases this general resistance of a mouse population more than 200 per cent. Also, certain diets increase the general resistance to infection or intoxication more than 200 per cent. So much for this epidemic disease of mice resembling typhoid fever, etc., in man.

The preceding study was preliminary to an investigation of the manner of spread of respiratory infections among animals. It is now recognized that the epidemic intestinal infections can be prevented in large measure by general sanitary regulations (affecting water, milk, etc.) and by preventive inoculation (typhoid-para-typhoid vaccination). No such measures of control have become generally applicable to the group of respiratory infections. Attention has therefore been given to a common respiratory disease of rabbits, popularly termed "snuffles," pleuro-pneumonia, and septicemia, which may be compared with pneumonia in man. The bacillary source of the infection is *Bacterium lepisepticum.*

This bacterium is of unstable activity and rapidly passes from high to low virulence. To secure suitable animal material for experiment is difficult, since domestic rabbits come usually from infected stocks. Having obtained suitable individuals by selective breeding, they react as follows to a highly virulent culture merely in-

stilled into the nares: the least susceptible remain well but carry the bacteria for variable periods; those somewhat less resistant develop the local condition of infection termed "snuffles" which pursues, as in nature, an irregular course. In the minority the infection subsides and the bacteria disappear. In another fraction it passes into a chronic disease attended by infection of the accessory sinuses, etc.; in still another fraction pneumonia develops leading to death in a few days. These various groups are also present in rabbit communities, where *Bacterium lepisepticum* is prevalent.

This factor of host susceptibility in the rabbit as in the mouse is composed of two parts or elements: one specific (immunity) and the other of more general or non-specific nature, the relation of which to each other comes to play a leading part in determining occurrence and the grade of infection. Finally, it has been found that *Bacterium lepisepticum* undergoes a change in the nasal passages of resistant individuals passing from the state of high to the state of low virulence. The reverse has never been observed.

The rôle of adrenal secretion in the chemical control of body temperature: W. B. CANNON. Earlier work from these laboratories by Aub, Bright and Forman,[1] and by McIver and Bright,[2] has shown that secretion from the adrenal medulla is capable of influencing the rate of metabolism in the body, and that increased secretion accelerates the oxidative processes. The erection of hairs, the ruffling of feathers, the constriction of peripheral vessels, the increase of blood sugar are well-known phenomena occurring when warm-blooded animals are exposed to cold. They are signs that the sympathetic division of the autonomic system is in action. Is secretion from the adrenal medulla, which is admitted to be under sympathetic control, augmented when cold causes a discharge of sympathetic impulses?

In 1923 Hartman and his co-workers,[3] using the denervated iris as an indicator, observed dilation of the pupil when the animals (cats) were wet with cold water, or when wet with warm water and later cooled by a fan. The dilation did not occur after adrenal secretion was suppressed by removal of the glands or by removal of one gland and denervation of the other. The method has been severely criticized by Stewart and Rogoff.[4] Moreover, wetting the animals had emotional effects which might have simulated a reaction to cold. We have investigated the reaction, therefore, by another method.

We have employed as an indicator of adrenal secretion the denervated heart, in animals surviving and living normally. The heart is then influenced only by temperature changes and by agents brought to it in the blood stream. It is highly sensitive to circulating adrenin — 0.00068 mg. of adrenalin per kilo per minute, injected intravenously, has increased the pulse 34 beats per minute. Cooling would decrease the rate. If cold makes the heart beat faster, therefore, the result would be in opposition to the influence of cold. The heart rate was determined by auscultation, by palpation and by electrical registration.

Animals thus prepared showed accelerations of heart rate varying from 12 to 43 per cent. when taken to a cold room, accelerations from 34 to 43 per cent. when placed in an ice box, an acceleration of 43 per cent. when held in the lap and exposed to the cold draught of an open window, and accelerations between 27 and 64 per cent. when cold water was introduced into the stomach. If the adrenal glands were rendered inactive the effects did not occur.

The use of cold water to produce what we have called a "heat liability" has several advantages: it can be used anywhere, it is easily available at any time, and it is satisfactorily quantitative. The weight, the temperature and the specific heat of the water are known in relation to the weight, the temperature and the specific heat of the body, and thus the heat liability can be nicely adjusted to the purposes of the experiment.

If the heat liability is more than 1,000 calories per kilo acceleration of the denervated heart (indicating increased adrenal secretion) is almost uniformly attended by shivering. Thus two calorigenic factors, adrenin and muscular movements, are at work to protect the body against a fall of body temperature. If a heat liability of 900 calories is to be met, shivering rarely occurs, and if it occurs, it is ofshort duration (3 minutes). The heart rate is faster, however, showing that the adrenal factor is operating. If now the adrenal glands are rendered inactive, and a heat liability of 900 calories is established, shivering almost uniformly occurs and may last for as long as 17 minutes. Thus when the heat-producing service of the adrenal medulla is lacking, the shivering mechanism is resorted to.

Establishing a heat liability of 574 calories per kilo in man, by giving 750 cc. of water at 1° C., has caused the metabolism to increase as much as 25 per cent. The peak of the increase occurred in five different experiments from 12 to 25 minutes after the cold water was given. In no case did shivering appear. When 750 cc. of water at 34.5° was given the maximal increase was 4 per cent.

The foregoing experiments have an important bearing on the long-waged controversy over the question of true chemical augmentation of metabolism, apart from muscular activity. They support the contentions of Voit and of Rubner that such a mechanism exists and they account for the mode of action of that mechanism.

Influence of experimental changes in blood sugar level on gastric hunger contractions: A. J. CARLSON. (1) Experimental hyperglycemia produced by intravenous injection of glucose inhibits normal gastric hunger contractions. This effect is not due to hypertonicity, since similar injection of lactose or sodium chloride does not have this effect. (2) In insulin hyperglycemia (normal dogs) increase in gastric tonus and hunger contractions (tetany) appears at a blood sugar concentration of 0.08 and 0.07 per cent. As the blood sugar falls towards the convulsion level, the stomach motor mechanism

[1] Aub, Bright and Forman: Am. Jour. Physiol., 1922, lxi, 349.

[2] McIver and Bright: *Ibid.*, 1924, lxviii.

[3] Hartman, McCordock and Lodie: *Ibid.*, 1923, lxiv, 19; and Hartman and Hartman: *Ibid.*, 1923, lxv, 612.

[4] Stewart and Rogoff: *Ibid.*, 1923, lxvi, 260.

usually shows alternate periods of atony and tetany, the inhibition predominating. Prior to the hyperglycemia gastric tetany, the gastric hunger contractions are more frequent and usually slightly stronger. (3) Glucose inhibits the gastric tetany of hyperglycemia. Lactose does not produce this effect. (4) In diabetic dogs insulin produces a primary depression of gastric tonus and contractions, followed by increased gastric tonus and contractions when the initial stage of hyperglycemia is reached. (5) Intravenous injections of glucose does not inhibit gastric tonus and hunger contractions in diabetic dogs except when hyperglycemia and gastric tetany are induced with insulin.

The influence of thermal environment upon basal metabolism: FRANCIS G. BENEDICT and CORNELIA GOLAY BENEDICT. Ten years ago the measurement of the heat production of a human being was a physiological curiosity, but to-day, since the heat production is found to be an excellent index of general tone or well-being and an important aid in diagnosis of goiter, a proceeding that ten years ago was a physiological curiosity has now become a pathological necessity. In the physician's diagnosis it is of the greatest importance to be able to compare the heat production of different individuals. Muscular activity of any kind and digestive processes have long been known to increase heat production, and scientists and physicians have accordingly insisted upon the greatest degree of repose when measuring the heat production and have waited until 12 hours after the last meal before making such tests. It is not merely to satisfy scientific curiosity, therefore, that so much labor is spent to find out under what conditions the least heat is produced. It has been believed that heat is produced to keep the body warm. A French scientist has proposed recently that, as heat is in part produced to keep the body warm and as people, even when clothed and lying covered with a steamer rug, are producing heat to combat the cooling effect of the surrounding air, all measurements of the minimum heat production must be made not in the air under ordinary conditions but with the body immersed in bath water at 98° F. This scientist argues that the heat production under this latter condition may be one third lower than under ordinary conditions. Experiments made at the Nutrition Laboratory to test this point show that if the metabolism is measured, first, with the subject lying, clothed and covered with one thin blanket, in a laboratory room at 60° F., and then with the body immediately thereafter immersed in a bath at 98° F., the heat production not only is not lowered in the bath, but usually is slightly increased. The extra heat is stored to warm up the large amount of peripheral body tissue that even with a normally clothed man is considerably below so-called body temperature, 98.6° F. When this warming is accomplished, then the temperature of the whole body will increase until again the heat loss just balances the heat production.

A comparison of the amoeba of the human bowel and that of the gums with special reference to the relationships of the amoeba in bone marrow in arthritis deformans: CHARLES A. KOFOID. Infections by the amoeba which produce so-called tropical amoebic dysentery are in some instances followed by the invasion of other organs of the body such as the liver, lung and brain, where they produce abscesses, or the skin where they are found in ulcers, or the lymph glands where they are found in Hodgkin's disease. They have also been reported from the genital and renal organs. Recently we have found them in the bone marrow adjacent to enlarged joints in chronic arthritis deformans of Ely's second type. Infections by amoeba in this region have been distinguished from normal and abnormal human cells, especially from the amoeba-like leucocytes, or white blood cells, by finding both human cells and amoebas in the division stages and determining the number of chromosomes in each. Amoeba has six and the human cells forty-eight. Clinical experience affords abundant evidence of a relationship between diseased teeth and some forms of arthritis. The gums around some diseased teeth and some supposedly normal teeth are also infected by an amoeba. These amoebas have a striking resemblance to those of the bowel, so much so as to raise the question as to whether or not the amoeba found by us in the bone marrow in arthritis might not be that of the mouth and diseased gums. A reinvestigation of the amoeba of the gums and of that of the bowel in motile stages both in the bowel and in infected organs elsewhere establishes the fact that these two amoebas are very distinct in the structure of their nuclei, and in their feeding habits. The amoeba of the gums feeds predominantly on white blood cells, that of the bowel on the red blood cells. The amoeba of the gums has no critical resemblance to the amoeba of the bone marrow which has the nuclear structure and feeding habits of that of the bowel. The amoeba of the gums is therefore not associated with this form of arthritis deformans. The portal of entry of the amoeba of bone marrow is the ulcerated bowel, not the abscesses of the gums.

The growth of marine animals on metallic surfaces: G. H. PARKER. These studies were made in connection with an investigation of the fouling of ship bottoms. The metals tested were aluminum, zinc, iron, tin, lead and copper. It was concluded that marine animals would grow upon any heavy metal provided that metal does not liberate ions or soluble compounds. The ions and soluble compounds of the heavy metals are usually extremely poisonous and where they are liberated freely from a metallic surface that surface is protected against organic growth. Such seems to be the case with zinc and copper. With aluminum, iron, tin and lead the products of marine corrosion are essentially insoluble and hence organisms grow upon these metals in the sea. By coupling copper with members higher in the electromotive series, this metal can be rendered chemically inactive in sea water and under such circumstances animals will grow freely upon it. Zinc in this respect is much less easily controlled, for it lies high in the electromotive series and consequently it is not open to the electrochemical protection that copper is. Its compounds moreover are relatively freely soluble and thus become very effective in checking the growth of animals.

Reactions in the female reproductive system following